

WHAT IS CLAIMED IS:

1 1. A method for determining which of a plurality
2 of programs has been selected to be received by a monitored
3 receiver, wherein each of the programs has an audio signal
4 portion and is transmitted as a sequence of data packets in
5 a corresponding channel, and wherein the monitored receiver
6 has a receiver audio output representative of an audio
7 signal portion of the selected program, the method
8 comprising the following:

9 a) comparing the receiver audio output with the
10 audio signal portion of each of the programs until a match
11 is found;

12 b) reading an identifying code from one of the
13 data packets associated with the matching program; and,

14 c) storing the identifying code as a time-stamped
15 record in a memory apparatus.

1 2. The method of claim 1 wherein the receiver
2 audio output comprises an audible acoustic signal, and
3 wherein a) comprises the following:

4 a1) acquiring, by way of a non-invasive sensor
5 disposed adjacent the monitored receiver, the receiver audio
6 output from the audible acoustic signal; and,

7 a2) comparing the acquired receiver audio output
8 with respective audio signal portions of each of the
9 programs until a match is found.

1 3. The method of claim 1 wherein a) comprises
2 scanning the audio signal portions based on historical
3 tuning of the monitored receiver.

1 4. The method of claim 1 wherein a) comprises
2 scanning the audio signal portions based on a list of
3 favorite stations or channels or programs.

1 5. The method of claim 1 wherein a) comprises
2 scanning the audio signal portions based on intercepted
3 remote control signals.

1 6. The method of claim 1 wherein a) comprises
2 scanning the audio signal portions based forecasts of the
3 likelihood of tuning choices.

1 7. The method of claim 1 wherein b) comprises the
2 following:

3 b1) demultiplexing a time-division multiplexed
4 sequence of data packets in order to generate a transport
5 bitstream associated with the program matching the receiver
6 audio output; and,

7 b2) reading the identifying code from the
8 transport bitstream.

1 8. The method of claim 1 wherein a) comprises the
2 following:

3 a1) selecting a channel or source;

4 a2) digitizing the receiver audio output;

5 a3) applying a first transform to the digitized
6 receiver audio output in order to obtain a receiver audio
7 output spectrum;

8 a4) applying a second transform to the audio
9 signal portion of one of the plurality of the programs in

10 the selected channel or source in order to generate a
11 corresponding audio signal portion spectrum;

12 a5) comparing the receiver audio output spectrum
13 and the audio signal portion spectrum to thereby generate a
14 single aggregate matching score;

15 a6) if the score exceeds a predetermined value,
16 deciding that the match has been found; and,

17 a7) if the score does not exceed the predetermined
18 value, selecting a different one of the plurality of
19 programs and repeating a4) through a7), as necessary.

1 9. The method of claim 8 wherein a) further
2 comprises returning to a1) if a6) and a7) do not result in a
3 match.

1 10. The method of claim 8 wherein the first and
2 second transforms are the same transforms.

1 11. The method of claim 10 wherein each of the
2 first and second transforms is a Modified Discrete Cosine
3 Transform.

1 12. The method of claim 10 wherein each of the
2 first and second transforms is a Fast Fourier Transform.

1 13. The method of claim 8 wherein a5) comprises
2 comparing the receiver audio output spectrum and the audio
3 signal portion spectrum at each of a plurality of
4 frequencies.

1 14. The method of claim 8 wherein at least one of
2 the first and second transforms is derived from less than
3 400 ms of a corresponding signal.

1 15. The method of claim 1 wherein a) comprises
2 the following:

3 a1) digitizing at least a portion of the receiver
4 audio output; and,

5 a2) extracting a feature set from the digitized
6 portion, wherein the digitized portion is at least as long
7 as is needed for the feature set plus a delay introduced by
8 the monitored receiver.

1 16. The method of claim 1 wherein a) comprises
2 comparing the receiver audio output with the audio signal
3 portion to produce a same output when the receiver audio
4 output and the audio signal portion match, a difference
5 output when the receiver audio output and the audio signal
6 portion do not match, a noise output when at least one of
7 the receiver audio output and the audio signal portion is
8 noisy, and a silent output when at least one of the receiver
9 audio output and the audio signal portion is silent.

1 17. The method of claim 16 wherein a) comprises
2 counting silent and noisy blocks of at least one of the
3 receiver audio output and the audio signal portion.

1 18. The method of claim 16 wherein a) comprises
2 transitioning between search, verification, wait-to-see, and
3 audio-off states.

1 19. The method of claim 1 wherein a) comprises
2 comparing weighted slopes of the receiver audio output with
3 weighted slopes of the audio signal portion.

1 20. The method of claim 1 wherein a) comprises
2 transitioning between search, verification, wait-to-see, and
3 audio-off states.

1 21. An apparatus for identifying a program
2 selected for reception on a monitored receiver having an
3 audio output, wherein the selected program comprises one of
4 a plurality of receivable programs, wherein each of the
5 plurality of receivable programs is distributed as a time-
6 division sequence of data packets at a corresponding one of
7 a plurality of radio frequencies, the apparatus comprising:

8 a tuner and demodulator arranged to receive a
9 predetermined one of the receivable programs;

10 a first feature extractor arranged to extract a
11 first set of characteristic features from the audio output;

12 a second feature extractor arranged to extract a
13 second set of characteristic features from the predetermined
14 program;

15 a comparator arranged to compare the first and the
16 second sets of characteristic features and to determine if
17 the first and the second sets of characteristic features
18 match;

19 a code extractor arranged to extract a program
20 identifying code from the predetermined program.

1 22. The apparatus of claim 21 wherein the
2 comparator comprises a microprocessor.

1 23. The apparatus of claim 21 further comprising
2 a microphone disposed adjacent the monitored receiver,
3 wherein the microphone is arranged to acquire the audio
4 output of the monitored receiver.

1 24. The apparatus of claim 21 further comprising
2 a coupling to an audio output connector of the monitored
3 receiver, wherein the coupling is arranged to acquire the
4 audio output of the monitored receiver.

1 25. The apparatus of claim 21 wherein the tuner
2 and demodulator includes a scanning tuner arranged to scan
3 through the plurality of programs and to provided the
4 scanned programs to the second feature extractor.

1 26. The apparatus of claim 25 wherein the
2 scanning tuner is arranged to scan through the plurality of
3 programs based on historical tuning of the monitored
4 receiver.

1 27. The apparatus of claim 25 wherein the
2 scanning tuner is arranged to scan through the plurality of
3 programs based on a list of favorite stations or channels or
4 programs.

1 28. The apparatus of claim 25 wherein the
2 scanning tuner is arranged to scan through the plurality of
3 programs based on an intercepted remote control signal.

1 29. The apparatus of claim 25 wherein the
2 scanning tuner is arranged to scan through the plurality of
3 programs based on forecasts of the likelihood of tuning
4 choices.

1 30. The apparatus of claim 21 wherein the second
2 feature extractor is arranged to demultiplex a time-division
3 multiplexed sequence of data packets in order to generate a
4 transport bitstream associated with the program matching the
5 receiver audio output, and wherein code extractor is
6 arranged to extract a program identifying code from the
7 transport bitstream.

1 31. The apparatus of claim 21 wherein:
2 the first feature extractor is arranged to
3 digitize the audio output and to apply a first transform to
4 the digitized audio output in order to obtain a receiver
5 audio output spectrum;
6 the second feature extractor is arranged to apply
7 a second transform to audio signal portions of each of the
8 programs in order to generate a program spectrum;
9 the comparator is arranged to compare the receiver
10 audio output spectrum and the program spectrum to thereby
11 generate a single aggregate matching score;
12 if the score exceeds a predetermined value, the
13 comparator is arranged to decide that the match has been
14 found; and,

15 if the score does not exceed the predetermined
16 value, the comparator is arranged to select a different one
17 of the programs and to repeat the comparison of the receiver
18 audio output spectrum and the program spectrum, as
.9 necessary.

1 32. The apparatus of claim 31 wherein the first
2 and second transforms are the same transform.

1 33. The apparatus of claim 32 wherein each of the
2 first and second transforms is a Modified Discrete Cosine
3 Transform.

1 34. The apparatus of claim 32 wherein each of the
2 first and second transforms is a Fast Fourier Transform.

1 35. The apparatus of claim 31 wherein the
2 comparator is arranged to compare the receiver audio output
3 spectrum and the program spectrum at each of a plurality of
4 frequencies.

1 36. The apparatus of claim 31 wherein at least
2 one of the first and second transforms is derived from less
3 than a predetermined time of a corresponding signal.

1 37. The apparatus of claim 21 further comprising
2 a memory arranged to store the program identifying code as a
3 time-stamped record.

1 38. The apparatus of claim 21 wherein the code
2 extractor is arranged to extract the program identifying
3 code only if the first and the second sets of characteristic
4 features match.

1 39. The apparatus of claim 21 wherein the first
2 feature extractor is arranged to digitize at least a portion
3 of the receiver audio output and to extract a feature set
4 from the digitized portion, wherein the digitized portion is
5 at least as long as is needed for the feature set plus a
6 delay introduced by the monitored receiver.

1 40. The apparatus of claim 21 wherein the
2 comparator is arranged to compare the first and second sets
3 of characteristic features so as to produce a same output
4 when the first and second sets of characteristic features
5 match, a difference output when the first and second sets of
6 characteristic features do not match, a noise output when at
7 least one of the first and second sets of characteristic
8 features is noisy, and a silent output when at least one of
9 the first and second sets of characteristic features is
10 silent.

1 41. The apparatus of claim 40 wherein the
2 comparator comprises silent and noisy blocks counters for at
3 least one of the first and second sets of characteristic
4 features.

1 42. The apparatus of claim 40 wherein the
2 comparator transitions between search, verification, wait-
3 to-see, and audio-off states.

1 43. The apparatus of claim 21 wherein the
2 comparator compares weighted slopes of the first and second
3 sets of characteristic features.

1 44. The apparatus of claim 21 wherein the
2 comparator transitions between search, verification, wait-
3 to-see, and audio-off states.

1 45. A method for determining which of a plurality
2 of programs has been selected to be received by a monitored
3 receiver, wherein each of the programs is transmitted as a
4 sequence of data packets in a corresponding channel, and
5 wherein the monitored receiver has a receiver output
6 representative of the selected program, the method
7 comprising the following:

8 a) comparing the receiver output with each of the
9 plurality of programs until a match is found; and,

10 b) reading an identifying code from one of the
11 data packets associated with the matching program.

1 46. The method of claim 45 wherein a) comprises
2 the following:

3 a1) acquiring, by way of a non-invasive sensor
4 disposed adjacent the monitored receiver, the receiver
5 output; and,

6 a2) comparing the acquired receiver output with
7 each of the plurality of programs until a match is found.

1 47. The method of claim 45 wherein a) comprises
2 scanning the plurality of programs based on historical
3 tuning of the monitored receiver.

1 48. The method of claim 45 wherein a) comprises
2 scanning the plurality of programs based on a list of
3 favorite stations or channels or programs.

1 49. The method of claim 45 wherein a) comprises
2 scanning the plurality of programs based on intercepted
3 remote control signals.

1 50. The method of claim 45 wherein a) comprises
2 scanning the plurality of programs based on forecasts of the
3 likelihood of tuning choices.

1 51. The method of claim 45 wherein a) comprises
2 the following:

3 a1) applying a first transform to the receiver
4 output in order to obtain a receiver output spectrum;

5 a2) applying a second transform to one of the
6 plurality of the programs in order to generate a
7 corresponding signal portion spectrum;

8 a3) comparing the receiver output spectrum and the
9 signal portion spectrum to thereby generate a score;

10 a4) if the score exceeds a predetermined value,
11 deciding that a match has been found; and,

12 a5) if the score does not exceed the predetermined
13 value, deciding that a match has not been found, selecting a
14 next one of the plurality of programs and repeating at least
15 a2) through a5).

1 52. The method of claim 51 wherein the first and
2 second transforms are the same transform.

1 53. The method of claim 52 wherein each of the
2 first and second transforms is Modified Discrete Cosine
3 Transform.

1 54. The method of claim 52 wherein each of the
2 first and second transforms is a Fast Fourier Transform.

1 55. A method for determining which of a plurality
2 of programs has been tuned by a monitored receiver, wherein
3 each of the programs is transmitted as a sequence of data
4 packets in a corresponding channel, and wherein the
5 monitored receiver has a receiver output representative of
6 the selected program, the method comprising the following:

7 a) determining a test power spectrum based upon
8 the receiver output;

9 b) determining a plurality of reference power
10 spectra based upon the plurality of programs;

11 c) comparing the test power spectrum with each of
12 the reference power spectra, as necessary, to determine a
13 match; and,

14 d) determining an identification indicia based
15 upon the match.

1 56. The method of claim 55 wherein a) comprises
2 applying a first transform to the receiver output in order
3 to obtain the test power spectrum, and wherein b) comprises
4 applying a second transform to the plurality of programs in
5 order to generate the plurality of reference power spectra.

1 57. The method of claim 56 wherein the first and
2 second transforms are the same transform.

1 58. The method of claim 57 wherein each of the
2 first and second transforms is a Modified Discrete Cosine
3 Transform.

1 59. The method of claim 57 wherein each of the
2 first and second transforms is a Fast Fourier Transform.

1 60. The method of claim 55 wherein the
2 identification indicia is a channel to which the monitored
3 receiver is tuned.

1 61. The method of claim 55 wherein the
2 identification indicia is a program label associated with a
3 program to which the monitored receiver is tuned.

1 62. The method of claim 55 wherein the
2 identification indicia is a station associated with a
3 channel to which the monitored receiver is tuned.

1 63. The method of claim 55 wherein a) comprises
2 determining n test power spectra based upon n sample blocks
3 of the receiver output, wherein b) comprises determining n
4 reference power spectra based upon one of the plurality of
5 programs, wherein c) comprises comparing the n test power
6 spectra with the n reference power spectra to form a single
7 match score, and wherein d) comprises determining an
8 identification indicia based upon the single match score.

1 64. The method of claim 55 wherein a) comprises
2 determining $n + m$ test power spectra based upon $n + m$ sample
3 blocks of the receiver output, wherein b) comprises
4 determining n reference power spectra based upon one of the
5 plurality of programs, wherein c) comprises comparing the n
6 + m test power spectra with the n reference power spectra to
7 form a single match score, and wherein d) comprises
8 determining an identification indicia based upon the single
9 match score.